WATER RESOURCES REVIEW for OCTOBER 1977

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

CANADA
DEPARTMENT OF THE ENVIRONMENT
WATER RESOURCES BRANCH

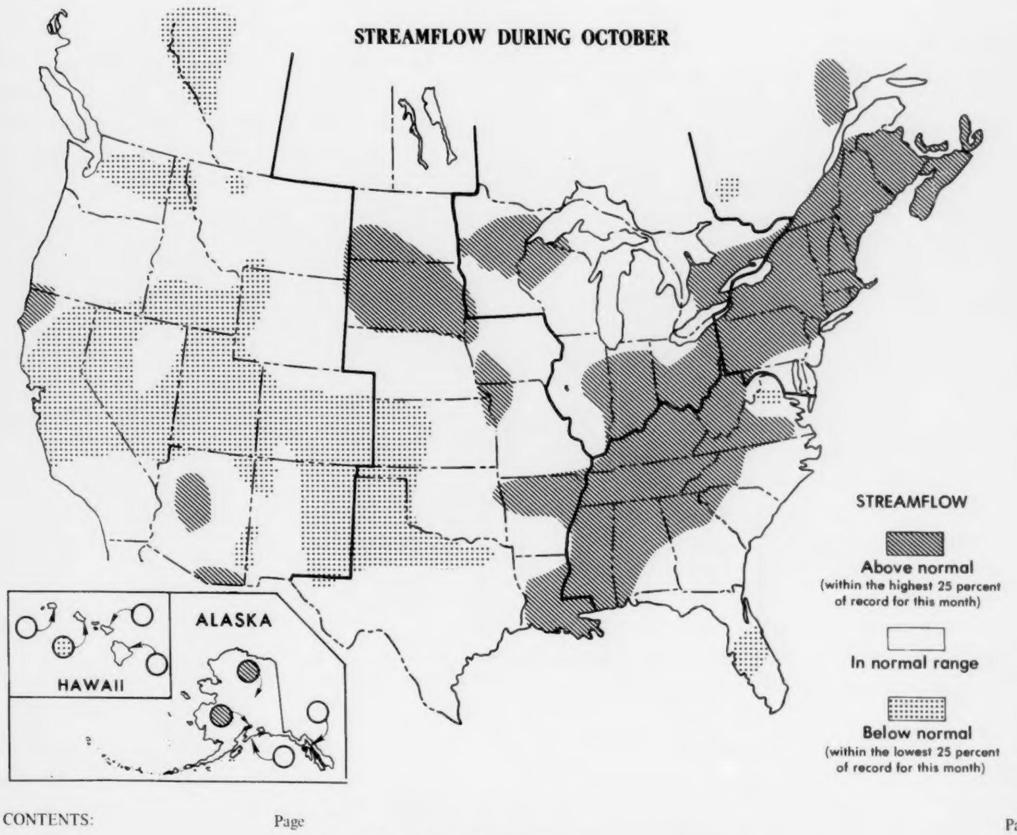
STREAMFLOW AND GROUND-WATER CONDITIONS

Serious drought conditions persisted in many western areas, most notably California, Nevada, Idaho, Utah, and Colorado, with monthly and daily mean flows the lowest of record in parts of California and Colorado. Contents of major reservoirs in northern California remained far below average.

Above-normal streamflow persisted in the Northeast and in many Central and Southeastern States and increased into that range in parts of Arizona, Arkansas, and South Dakota. Monthly and daily mean flows were highest of record in parts of Quebec, Alabama, Alaska, Arizona, New Hampshire, New York, North and South Dakota, and Maine. Flooding occurred in Arizona, Kansas, Louisiana, Missouri, North Carolina, Tennessee, Texas, and Virginia.

Ground-water levels rose and were above average with several October record high levels in the Northeast. Mixed trends prevailed in much of the Southeast, with a new high level in Alabama and a new low in Tennessee; levels declined in Virginia and Florida but rose in Georgia and Alabama. In the Western Great Lakes Region, levels rose in Minnesota, Wisconsin, and Indiana, and declined in northwestern Illinois, and showed mixed trends in Michigan and Ohio. In the Midcontinent and West, levels generally rose in North Dakota, Arkansas, Nebraska, Arizona, and New Mexico; declined in Idaho, Montana, and southern California; and were variable in other States.

STREAMFLOW DURING OCTOBER



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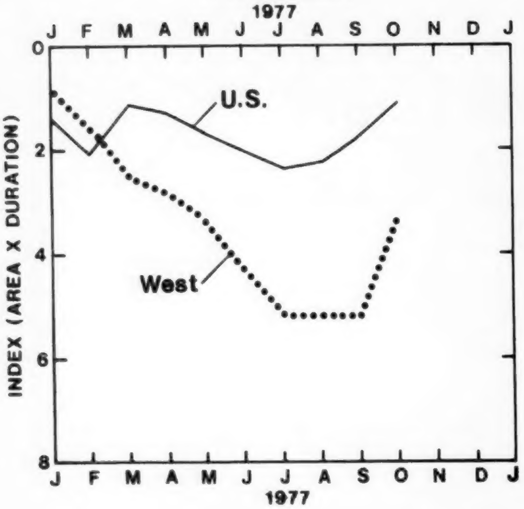
INDEX OF STREAMFLOW DEFICIENCY (Provisional)



The index of deficient streamflow continued to improve from a value of 1.8 in September to a value of 1.1 in October, as the area affected by below-normal flows contracted. In the West, the index decreased to 3.2 as low flows persisted in 45 percent of the region. In the Northeast, the index of excessive streamflow increased from a value of 1.0 in September to a value of 2.0 in October. [Index = area of deficiency (excess) X monthly duration of deficiency (excess)]

NORTHEAST

[Atlantic Provinces and Quebec; Delaware, Maryland, New Jersey, New York, Pennsylvania, and the New England States]

Streamflow generally increased seasonally throughout the region except in part of Maryland where a contraseasonal decrease occurred. Monthly mean flows were above the normal range in parts of each State and Province except Maryland and Delaware. Monthly mean flows were highest of record for the month in parts of Quebec, Maine, New York, and New Hampshire.

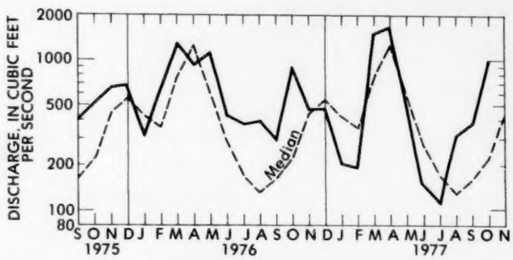
Ground-water levels rose and were above average in most of the region, reaching the highest October levels in 20–30 years in some northern and central areas.

In Maine, monthly mean discharge at the three index stations increased seasonally and flows were above the normal range throughout the State. At the index station, Little Androscoggin River near South Paris (drainage area, 76.2 square miles), in the southern part of the State, the monthly mean flow of 557 cfs, and the daily mean of 1,780 cfs on the 10th, were highest for October in 56 years of record. This monthly mean discharge was 20 times the October median flow. In central Maine, at the index station Piscataquis River near Dover-Foxcroft (drainage area, 297 square miles) the monthly mean discharge of 2,143 cfs was over 10 times the October median and highest for the month since records began in 1902. In northern Maine, the monthly mean discharge of 20,340 cfs in St. John River below Fish River, at Fort Kent (drainage area, 5,690 square miles), was highest for the month in 51 years of record.

In the Atlantic Provinces, streamflow increased at all index stations, ranged from 2 to 6 times the monthly median, and was above the normal range.

In the extreme southern part of Quebec, south of the St. Lawrence River, high carryover flow from September, augmented by runoff from moderate thunderstorms throughout the month, resulted in a monthly mean discharge of 16,700 cfs at the index station, St. Francois River at Hemming Falls (drainage area, 3,710 square miles). That monthly mean was nearly 5 times the October median and highest for the month in 51 years of record. In the western part of the Province, flow in Harricana River at Amos increased seasonally but was below the normal range at 77 percent of median. In the extreme eastern part of the Province, monthly mean flow at the index station, Outardes River at Outardes Falls, increased seasonally and was above the normal range.

In northern New York, flow of West Branch Oswegatchie River at Harrisville continued to increase seasonally and remained above the normal range for the 3d consecutive month. (See graph.) In south-central New York, the monthly mean discharge of 12,710 cfs in Susquehanna River at Conklin (drainage area, 2,232 square miles) was highest for October in 65 years of record and marked the 2d consecutive month of record high monthly flows at that site. In the eastern part of the State, mean flows in Hudson River at Hadley and



Monthly mean discharge of West Branch Oswegatchie River near Harrisville, N.Y. (Drainage area, 258 sq mi; 668 sq km)

Mohawk River at Cohoes increased seasonally as a result of heavy rains near midmonth and remained in the above-normal range.

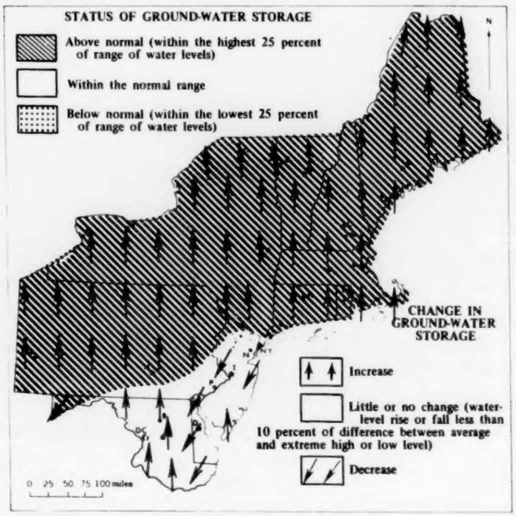
In central New Hampshire, the monthly mean discharge of 3,424 cfs in Pemigewasset River at Plymouth (drainage area, 622 square miles) was highest for the month in record that began in 1903. Elsewhere in the New England States, monthly mean flows ranged from 5 to 7 times median at the index stations as a result of frequent precipitation during the first 20 days of the month. Monthly mean discharges that were 2d and 3d highest for period of record occurred on many streams but peak flows, although high, were not outstanding.

In Connecticut, streamflow increased seasonally at all index stations, ranging from 5 to 8 times the median, and remained in the above-normal range for the 2d consecutive month.

In northwestern Pennsylvania, monthly mean discharge at the index station, Oil Creek at Rouseville, increased seasonally and remained in the above-normal range for the 4th consecutive month. Elsewhere in the State, streamflow increased seasonally and ranged from 3 to nearly 9 times the median flows for October and were above the normal range.

Similarly, streamflow in northern New Jersey was above the normal range as a result of above-normal precipitation during the month. At the index station, South Branch Raritan River near High Bridge, monthly mean discharge increased sharply and was over 2 times the median flow.

Ground-water levels rose in nearly the entire region. (See map.) Principal exceptions, where levels either declined or remained about the same, were western Maryland, most of Delaware and New Jersey, and on Long Island, New York. Levels near end of month were above average in New England, New York, and Pennsylvania, reaching the highest October levels of record during the past 20–30 years in some areas. Levels remained near or below average in much of Maryland, Delaware, and New Jersey, and on Long Island, New York.



Map shows ground-water storage near end of October and change in ground-water storage from end of September to end of October.

SOUTHEAST

[Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia]

Streamflow increased in Kentucky, Virginia, and West Virginia, decreased in Florida, North Carolina, and South Carolina, and was variable in other States in the region. Above-normal flows persisted in parts of Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee, and Virginia. Flows increased from the normal range into the above-normal range in West Virginia and remained below the normal range in northern Virginia. Flooding occurred in parts of North Carolina, Tennessee, and Virginia. Monthly and daily mean flows were highest of record for October in central Alabama.

Ground-water levels showed mixed trends in much of the region. Levels generally declined and were below average in Virginia and Florida, and rose and were above average in Alabama and Georgia. A new alltime high was reached in Alabama, and a new October low in Tennessee.

In Cahaba River basin, in central Alabama, flow at the index station at Centreville (drainage area, 1,029 square miles) increased sharply near monthend and the monthly mean discharge of 2,433 cfs, and the daily mean of 12,700 cfs on the 26th were highest for the month in 50 years of record. In the northwestern part of the State, monthly mean flow in Tombigbee River at Demopolis lock and dam, near Coatopa, also increased sharply, was 10 times the October median flow, and remained above the normal range.

In southeastern Mississippi, mean flow in Pascagoula River at Merrill decreased seasonally but remained above the normal range and was 2½ times median. Elsewhere in the State, streamflows generally increased contraseasonally. In northeastern Mississippi, flow of Tombigbee River at Columbus increased into the above-normal range and was 7 times median, while in central Mississippi, monthly mean discharge of Big Black River near Bovina also increased into the above-normal range,

and was 6 times the October median flow at that site.

In extreme northeastern Tennessee, in Carter, Sullivan, and Johnson Counties, rapid runoff from very heavy rain October 1, 2, caused extensive property damage in the cities of Bristol, Tenn.–Va., and Kingsport. Many private bridges were destroyed along Doe Creek in Johnson County. In the east-central part of the State, where mean flow in Emory River at Oakdale (drainage area, 764 square miles) was in the above-normal range and 16 times median in September, flow increased to 1,694 cfs in October, remained above the normal range, was 30 times median, and was 2d largest for the month since records began in June 1927. In the north-central part of the State, mean flow in Harpeth River near Kingston Springs also increased and remained above the normal range, and was almost 8 times the median flow for October.

In Kentucky, monthly mean flows in Green River at Munfordville and Licking River at Catawba increased sharply as a result of runoff from intense rains early in the month, were above the normal range, and were 13 times their respective median discharges for October.

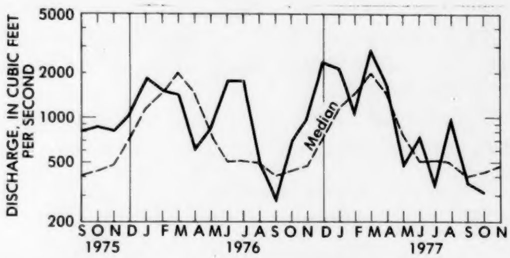
In central and southeastern West Virginia, flows in Kanawha River at Kanawha Falls and Greenbrier River at Alderson increased sharply into the above-normal range (from the normal range) and were 2 and 5 times their respective median flows for October. In the northern part of the State, monthly mean flow in Potomac River at Paw Paw increased into the normal range (from the below-normal range) and was slightly greater than median. Downstream near Washington, D.C., monthly mean flow in Potomac River also increased sharply and was in the normal range but was slightly less than median for the month.

In extreme southwestern Virginia, flow in North Fork Holston River near Saltville increased early in the month as a result of runoff from intense rains October 1, 2, and the monthly mean discharge was 8 times the monthly median flow. Rapid runoff from the same storm caused flooding in the Bristol, Tenn.–Va., area. The peak stage of 9.94 feet at the gaging station on Beaver Creek at Bristol, Va. (drainage area, 27.7 square miles), was 1.83 feet higher than the maximum stage observed since records began in 1957. A flood at this site in 1936 reached a stage of about 12 feet. In the southeastern part of the State, flow in Nottaway River near Stony Creek increased near monthend and the monthly mean discharge was above the normal range for the first time since December 1976. In northern Virginia, monthly mean discharge in Rapidan River near Culpeper remained below the normal range for the 8th time in the past 9 months and was only 1/3 of median, but was 4 times the record-low monthly mean flow for October that occurred in 1954.

In western North Carolina, mean flows in French Broad River at Asheville and South Yadkin River near Mocksville decreased contraseasonally but remained within the above-normal range. In the southern Piedmont, significant flooding occurred in Union County on October 26, 27, as a result of rapid runoff from rainfall of 6.2 inches in 24 hours (National Weather Service). About 20 roads were inundated in the county. The peak discharge at the gaging station, Twelve Mile Creek near Waxhaw, was equal to that of a 10-year flood.

In northern Georgia, monthly mean discharge in Oconee River near Greensboro and Etowah River at Canton increased contraseasonally and were in the above-normal range. Elsewhere in the State, flows decreased and were less than median but were within the normal range.

In northeastern South Carolina, mean flow in Pee Dee River at Peedee decreased seasonally and was less than median but was within the normal range. In the adjacent basin of Lynches River, mean flow at the index station, Lynches River at Effingham, decreased contraseasonally, was less than median, but was within the normal range. (See graph.)



Monthly mean discharge of Lynches River at Effingham, S.C. (Drainage area, 1,030 sq mi; 2,668 sq km)

In west-central Florida, monthly mean flow in Peace River at Arcadia decreased seasonally and was in the below-normal range for the 6th time in the past 7 months. In the northwestern part of the State, mean flow in Shoal River near Crestview decreased seasonally and was in the normal range, after 2 months in the above-normal range. Also in northern Florida, and the adjacent areas of Georgia, mean flows in Apalachicola River at Chattahoochee, and Suwannee River at Branford decreased seasonally, were less than their respective October median flows, and were within the normal range.

Ground-water levels in West Virginia declined in the east-southeast third of the State and in the northern panhandle, and rose elsewhere. Levels were above average in the northwestern third of the State and in two

southern border counties, and were below average elsewhere. In Kentucky, levels rose slightly in the shallow aquifers in the eastern and western parts of the State, but generally declined seasonally elsewhere. Levels in Virginia declined and were below average in all three key observation wells. In western Tennessee, the artesian level in the key well in the "500-foot sand" near Memphis was at a new October low, despite a slight rise; the level was more than 15 feet below average. In North Carolina, levels declined in the mountains and Piedmont, but rose in the Coastal Plain; levels were above average in the mountains and western Piedmont and below average in the eastern Piedmont and Coastal Plain. Levels in Mississippi generally declined, except in wells in the Sparta Sand in the Jackson metropolitan area—probably caused by reduction of withdrawals because of decreased irrigation and cooling requirements. Levels in Alabama were generally above average; the level in the key well in Centreville rose more than 3 feet, was 4 1/2 feet above average, and reached a new alltime high in 25 years of record. In Georgia, levels rose in the Piedmont in response to heavy rains, and were above average. Levels showed little change in the Savannah area, and rose slightly in Bryan and Liberty Counties. In the Brunswick area farther south, they rose about 2 feet during the month. In Florida, levels generally declined in the north and southeast in response to near-record low rainfall during the month. End-of-month levels were generally below average in most parts of the State.

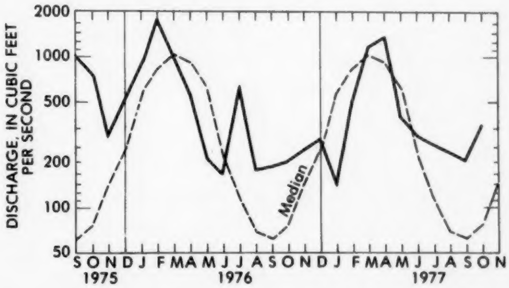
WESTERN GREAT LAKES REGION

[Ontario; Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin]

Streamflow decreased in northwestern Wisconsin and eastern Ontario but increased in all other parts of the region. Flows remained in the above-normal range throughout Indiana and in parts of Illinois, Michigan, Minnesota, Ohio, and Wisconsin, and increased into that range in southeastern Ontario.

Ground-water levels rose in Minnesota, Wisconsin, and Indiana, showed mixed trends in Michigan and Ohio, and declined in northwestern Illinois. Levels were below average in Minnesota and Michigan, and above average in northwestern Illinois, and in Indiana and Ohio.

Monthly mean discharges increased sharply, and greatly exceeded the normal October flows, in parts of the southern States of the region. For example, in central Illinois, mean flow in Sangamon River at Monticello increased contraseasonally and was 58 times the median discharge for October, but was less than one-half the maximum monthly mean discharge for October in 67 years of record. In the southeastern part of that State, monthly mean discharge in Skillet Fork at Wayne City also increased contraseasonally and was 10 times the October median. In Indiana, mean flows at all three index stations increased sharply and were about 5 times median, and in eastern Ohio, monthly mean flow in Little Beaver Creek near East Liverpool also increased sharply, remained in the above-normal range for the 4th consecutive month, and was about 5 times median. (See graph.)



Monthly mean discharge of Little Beaver Creek near East Liverpool, Ohio (Drainage area, 496 sq mi; 1,285 sq km)

In southeastern Ontario, monthly mean flow in Saugeen River near Port Elgin increased seasonally, remained above the normal range for the 3d consecutive month, and was 4 times the median flow for October. Elsewhere in the Province, streamflow increased seasonally in the western part, decreased contraseasonally in the east, and was within the normal range.

In Minnesota, mean flows in Mississippi River at St. Paul and Buffalo River near Dilworth increased contraseasonally into the above-normal range (from the normal range), while flows in Minnesota River near Jordan and Crow River at Rockford were increasing contraseasonally from the below-normal range into the normal range. Monthly mean flows were less than median in streams along the Minnesota - South Dakota border and in the extreme southeastern corner of the State.

In northwestern Wisconsin, mean flows in Jump River at Sheldon and Chippewa River at Chippewa Falls decreased but remained above the normal range. Elsewhere in Wisconsin, and in the neighboring State of Michigan, monthly mean discharges increased but remained within the normal range.

Reservoir storage in Ohio generally decreased and was slightly less than that of a year ago, but monthend storage in the Mississippi River Headwaters Reservoirs System increased and was 254 percent of last year.

(Continued on page 7.)

SELECTED DATA FOR THE GREAT LAKES, GREAT SALT LAKE, AND OTHER HYDROLOGIC SITES

GREAT LAKES LEVELS

Water levels are expressed as elevations in feet above International Great Lakes Datum 1955

(Data furnished by National Ocean Survey, NOAA, via U.S. Army Corps of Engineers office in Detroit. To convert data to elevations above mean sea level datum of 1929, add the following values: Superior, 0.96; Michigan-Huron, 1.20; St. Clair, 1.24; Erie, 1.57; Ontario, 1.22.)

Lake	October 31, 1977	Monthly mean, October		October		
		1977	1976	Average 1900–75	Maximum (year)	Minimum (year)
Superior (Marquette, Mich.)	601.21	601.32	600.79	600.96	601.93 (1951)	599.49 (1925)
Michigan and Huron (Harbor Beach, Mich.)	578.32	578.41	579.41	578.26	580.45 (1973)	575.77 (1964)
St. Clair (St. Clair Shores, Mich.)	573.98	574.10	574.66	573.22	575.35 (1973)	571.13 (1934)
Erie (Cleveland, Ohio)	571.16	571.34	571.68	570.12	572.14 (1973)	567.95 (1934)
Ontario (Oswego, N.Y.)	244.80	245.00	245.06	244.31	246.33 (1945)	241.72 (1934)

GREAT SALT LAKE

Alltime high: 4,211.6 (1873). Alltime low: 4,191.35 (October 1963).	October 31, 1977	October 31, 1976	Reference period 1904–76		
			October average, 1904–76	October maximum (year)	October minimum (year)
Elevation in feet above mean sea level:	4,198.75	4,200.30	4,197.6	4,204.0 (1923)	4,191.35 (1963)

LAKE CHAMPLAIN, AT ROUSES POINT, N.Y.

Alltime high (1827–1975): 102.1 (1869). Alltime low (1939–1975): 92.17 (1941).	October 28, 1977	October 31, 1976	Reference period 1939–75		
			October average, 1939–75	October max. daily (year)	October min. daily (year)
Elevation in feet above mean sea level:	98.74	97.31	94.43	97.96 (1946)	92.90 (1942)

FLORIDA

Site	October 1977		September 1977	October 1976
	Discharge in cfs	Percent of normal	Discharge in cfs	Discharge in cfs
Silver Springs near Ocala (northern Florida)	600	71	620	800
Miami Canal at Miami (southeastern Florida)	259	55	441	320
Tamiami Canal outlets, 40-mile bend to Monroe	550	95	960	553

(Continued from page 5.)

Ground-water levels in shallow water-table wells in Minnesota rose but remained below average. In the Minneapolis-St. Paul area, artesian levels continued to rise in wells tapping the Prairie du Chien-Jordan aquifer, and the deeper Mt. Simon-Hinckley aquifer; both remained below average. In Wisconsin, levels rose in areas where there was abundant rainfall, and generally remained constant elsewhere in the State. In Michigan, levels continued to decline and were below average in most areas in the Lower Peninsula; in the Upper Peninsula, levels rose in response to rains but continued below average. In northwestern Illinois, the level in the shallow index well in glacial drift at Princeton, in Bureau County, declined nearly a foot but was nearly 6 feet above average. Levels in the southern two-thirds of Indiana rose during the month and continued above average; in the north, they remained near the end-September levels and continued above average. Levels in northeastern Ohio rose substantially and were above average; levels in central Ohio declined slightly but were about average at month's end.

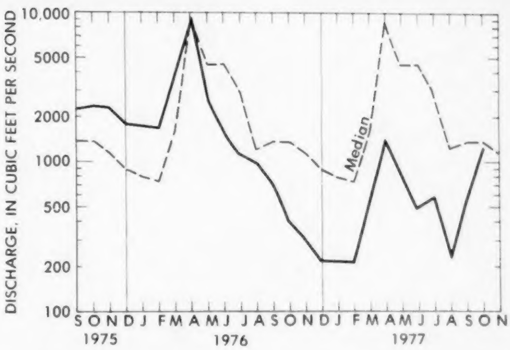
MIDCONTINENT

[Manitoba and Saskatchewan; Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, and Texas]

Streamflow increased contraseasonally in Manitoba, Saskatchewan, North Dakota, and South Dakota, decreased seasonally in Kansas, and was variable elsewhere in the region. Monthly mean flows remained above the normal range in parts of Iowa, Louisiana, Missouri, and North Dakota, and increased into that range in parts of Arkansas and South Dakota. Below-normal flows persisted in parts of Texas and decreased into that range in parts of Kansas and Oklahoma. Monthly and daily mean discharges were highest of record for the month in parts of North and South Dakota. Flooding occurred in Kansas, Louisiana, Missouri, and Texas.

Ground-water levels generally rose in North Dakota, and showed mixed trends in Iowa, Kansas, Arkansas, Louisiana, and Texas. Levels were generally near or above average in North Dakota, Nebraska, Iowa; below average in Arkansas; and above and below average in Texas. A new October high was reached in Iowa and new October lows were noted in Arkansas and Texas.

In North Dakota, flow at the index station, Red River of the North at Grand Forks, increased contraseasonally and was in the normal range after 13 consecutive months of below-normal flows. (See graph.) In the southwestern part of the State, the monthly mean discharge of 290 cfs, and the daily mean of 802 cfs on the 8th, in Cannonball River at Breien (drainage area, 4,100 square miles) were highest for the month in 43 years of record. Monthly and daily means have been highest of record at Breien for 2 consecutive months.



Monthly mean discharge of Red River of the North at Grand Forks, N. Dak. (Drainage area, 30,100 sq mi; 78,000 sq km)

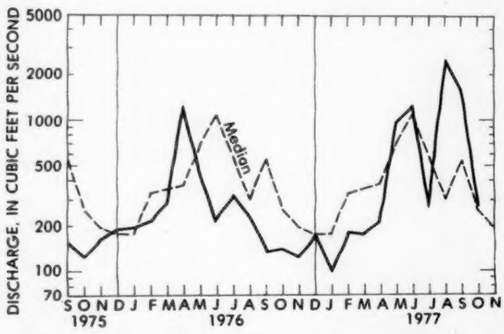
In the Big Sioux River basin in eastern South Dakota and the adjacent areas of Minnesota and Iowa, the monthly mean discharge of 917 cfs, and the daily mean of 2,840 cfs on the 4th, at the index station at Akron, Iowa (drainage area, 9,030 square miles), were the highest for October in 49 years of record. In the central part of the State, flow at the index station, Bad River near Fort Pierre, increased sharply to over 1,600 times the median and was well above the normal range.

In northwestern Iowa, monthly mean flow at the index station on the Des Moines River at Fort Dodge, increased contraseasonally to 86 percent of median, and was in the normal range after 18 consecutive months of flow in the below-normal range. In the southwestern part of the State, mean flow at the index station, Nishnabotna River above Hamburg, decreased seasonally but remained in the above-normal range as a result of frequent soaking rains with occasional heavy thunderstorms that were common over much of the State.

In northwestern Missouri, monthly mean discharge at the index station, Grand River near Gallatin, decreased contraseasonally, was nearly 9 times the monthly median, and remained in the above-normal range for the 2d consecutive month. Heavy rains on October 8–9 and again on October 25–26 caused bankfull stages with some lowland flooding in the Grand, Platte, Little Platte, and Blackwater River basins.

In north-central Kansas, where monthly mean flow at the index station, Little Blue River near Barnes, was highest of record during August and above the normal range in September, streamflow during October

decreased seasonally and was within the normal range. (See graph.) In the western part of the State, streamflow



Monthly mean discharge of Little Blue River near Barnes, Kans. (Drainage area, 3,324 sq mi; 8,609 sq km)

also decreased seasonally at the index station, Saline River near Russell, and was below the normal range at only 23 percent of median. In extreme northeastern Kansas, heavy rains of up to 5 inches during the period October 22–24 caused minor flooding in the Lawrence-Kansas City area, mostly along Stranger Creek.

In northern Arkansas, streamflow increased sharply at the index station, Buffalo River near St. Joe, to over 5 times the October median and was above the normal range. Elsewhere in the State, mean flows were generally in the normal range.

In west-central Louisiana, monthly mean flow at the index station, Calcasieu River near Oberlin, increased contraseasonally to nearly 5 times the monthly median and was above the normal range as a result of locally heavy rain on the 23d. Some flooding occurred in the vicinity of Oakdale, upstream from Oberlin. In the southeastern part of the State, flows in Pearl River near Bogalusa and Amite River near Denham Springs remained in the above-normal range at 3 and 2 times their respective monthly means.

In Texas, locally heavy rains on October 22 produced brief flooding in the Frio and Sabinal River basins. Streamflow was generally in the normal range in the southern part of the State and below the normal range elsewhere.

In Manitoba, monthly mean discharge in Waterhen River below Waterhen Lake continued to increase contraseasonally but remained within the normal range. The level of Lake Winnipeg at Gimli averaged 711.74 feet above mean sea level for the month, 1.86 feet below the long-term mean, and 0.08 foot higher than the average level last month.

Ground-water levels in North Dakota rose significantly Statewide and were near average levels by the end of the month. In Nebraska, levels generally rose except for a slight decline in the western part of the State; levels were generally above average except where affected by pumping for irrigation or municipal supplies. Levels in shallow water-table wells in Iowa rose and declined in response to local precipitation, but with no general trend; however, all levels were well above average, and a new October high was recorded in Johnson County. In Kansas, levels generally declined slightly except in the key well in Harvey County, which rose 0.41 foot. The general ground-water situation is encouraging in much of the State––levels rising in places nearly 5 feet. However, in western Kansas, declines of more than a foot were recorded. In the rice-growing area of east-central Arkansas, levels rose slightly in the shallow aquifer. Levels rose about 21 feet in the deep aquifer––the Sparta Sand––following the close of the irrigation season; even so, the levels were about 22 feet below average. In the industrial aquifer of central and southern Arkansas––also the Sparta Sand––the level in the key well at Pine Bluff declined and was nearly 14 feet below average––a new low for October. At El Dorado, levels rose 3¼ feet during the month. Levels showed mixed trends in Louisiana, declining in the northern and central parts of the State and continuing to recover in the Chicot aquifer in the southwestern part. Levels in the terrace aquifer in the north were above average. Levels in the New Orleans area reached seasonal lows early in the month, but showed little change elsewhere in southeastern Louisiana. In Texas, levels rose at San Antonio and El Paso, but declined at Austin. Levels were above average in the Edwards Limestone at Austin and San Antonio, but below average in the bolson deposits at El Paso. A new October low was reached at El Paso.

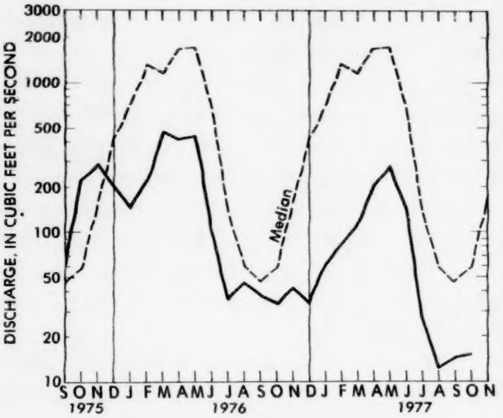
WEST

[Alberta and British Columbia; Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming]

Streamflow increased seasonally in California, Idaho, Nevada, Oregon, Washington, and Wyoming, generally decreased in Alberta and New Mexico, and was variable elsewhere in the region. Monthly mean flows remained in the below-normal range in parts of Alberta, California, Colorado, Idaho, New Mexico, Utah, Washington, and Wyoming, and decreased into that range in parts of Arizona and Montana. Monthly and daily mean discharges were lowest of record for the month in parts of California and Colorado. Flows remained in the above-normal range in parts of California, and increased into that range in parts of Arizona, where flooding and record-high flows occurred.

Ground-water levels showed mixed trends but were below average in Washington and Utah. Levels rose in Nevada, Arizona and New Mexico, but were below average, and levels in several wells in these States were at new October lows. Levels declined and were below average in Idaho, Montana, and southern California.

In north-coastal California, where monthly mean flow in Smith River near Crescent City increased into the above-normal range in September, increased runoff from rains near the end of October resulted in sharply increased flow. The mean discharge during October remained above the normal range and was 2½ times median. Also in northern California, on the Sierra Nevada west slope, the monthly mean discharge of 15.5 cfs in North Fork American River at North Fork Dam (drainage area, 342 square miles) was lowest for October in 66 years of record. This was the 3d consecutive new record-low monthly mean discharge at this station. (See graph.) On the central Sierra Nevada east slope, in



Monthly mean discharge of North Fork American River at North Fork Dam, Calif. (Drainage area, 342 sq mi; 886 sq km)

northern California, monthly mean flow of West Walker River below Little Walker River, near Coleville (drainage area, 180 square miles) increased contraseasonally and was in the below-normal range for the 19th time in the past 21 months. The monthly mean discharge of 16.5 cfs and the daily mean of 13 cfs on the 1st, were lowest for October since records began in April 1938. This was the 7th new minimum monthly mean discharge in the past 10 months at this station.

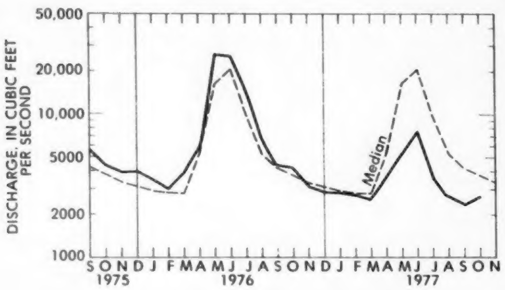
In the southern part of the Sierra Nevada, monthly mean flow in Kings River above North Fork, near Trimmer (drainage area, 952 square miles), increased contraseasonally but was in the below-normal range for the 11th consecutive month and for the 18th time in the past 22 months. The daily mean discharge of 70 cfs on the 5th was the lowest for October in 48 years of record. October rainfall produced little runoff to reservoirs and monthend storage in major reservoirs in northern California was only 34 percent of average and 48 percent of that of a year ago.

In central Colorado, east of the Continental Divide, the monthly mean discharge of 147 cfs, and the daily mean of 119 cfs on the 26th, in Arkansas River at Canon City (drainage area, 3,117 square miles) were lowest for the month in 89 years of record. This was the 6th time in the past 10 months that monthly mean discharge has been lowest of record for the respective month. Also in central Colorado, but west of the Divide, monthly mean flow in Roaring Fork River at Glenwood Springs increased but remained below the normal range for the 11th time in the past 12 months. Also west of the Divide, monthly mean discharge in Yampa River at Steamboat Springs increased seasonally and was in the normal range, following 11 consecutive months of flow in the below-normal range. In southwestern Colorado, mean discharge in Animas River at Durango decreased seasonally and was less than median but remained within the normal range.

In Utah, streamflow increased in some basins and decreased in others and was slightly greater, relative to median flow, than last month, but was below the normal range in all parts of the State and appreciably less than a year ago. In the southwestern part of the State, where monthly mean flows in Beaver River near Beaver (drainage area, 90.7 square miles) have been below the normal range for 20 consecutive months, and where both the monthly and minimum daily mean flows were lowest of record for the respective months of July, August, and September, the mean discharge of 13.1 cfs in October was only 0.2 cfs greater than the minimum October mean in 63 years of record, and the daily mean of 10 cfs on the 10th was the same as the record-low daily mean for the month, that occurred in 1934. In extreme southwestern Utah, and the adjacent areas of Arizona and Nevada, monthly mean flow in Virgin River, as measured at Littlefield, Arizona, remained unchanged from September but was below the normal range. In San Juan River basin, southeastern Utah, and the adjacent areas of Arizona, Colorado, and New Mexico, mean flow in San Juan River near Bluff, Utah, decreased sharply, was only 1/3 of the October median flow, and remained below the normal range. In the east-central part of the State, monthly mean flows in Colorado River near Cisco and Green River at Green River increased seasonally, but both remained in the below-normal range for the 9th consecutive month. In northern Utah, mean flow in Weber River near Oakley

increased contraseasonally but remained below the normal range for the 14th consecutive month. Also in northern Utah, mean flow in Whiterocks River near Whiterocks decreased into the below-normal range after 2 months within the normal range, and mean flow in Big Cottonwood Creek near Salt Lake City decreased seasonally and remained within the below-normal range for the 8th time in the past 9 months.

In central Idaho, where flow in Clearwater River at Spalding increased into the above-normal range in September, flow increased seasonally in October but mean discharge was in the normal range. Also in the central part of the State, mean flow in Salmon River at Whitebird increased sharply as a result of increased runoff from rains near monthend, and was near median and within the normal range following 9 consecutive months of below-normal flows. In southwestern Idaho, mean flow in Snake River at Weiser increased seasonally but remained within the below-normal range for the 9th consecutive month. Upstream, in the headwaters of Snake River, in southeastern Idaho and the adjacent area of Wyoming, mean discharge as measured at Heise, Idaho, increased contraseasonally but remained below the normal range for the 11th time in the past 12 months. (See graph.) In northern Idaho, flow in Kootenai River remained within the normal range.



Monthly mean discharge of Snake River near Heise, Idaho
(Drainage area, 5,752 sq mi; 14,898 sq km)

In Montana, streamflow increased in some basins and decreased in others. Monthly mean discharge in Yellowstone River at Corwin Springs, in the south-central part of the State, decreased seasonally and remained below the normal range for the 6th consecutive month. Downstream at Billings, flow increased contraseasonally and was in the normal range, following 5 consecutive months of below-normal flow. In northwestern Montana, west of the Continental Divide, where mean flow in Middle Fork Flathead River near West Glacier was above the normal range in September, flow decreased contraseasonally and was in the normal range. Also west of the Divide, monthly mean discharge in Clark Fork at St. Regis increased seasonally and was in the normal range, after 9 consecutive months of below-normal flow. East of the Divide, in northwestern Montana, mean flow in Marias River near Shelby decreased contraseasonally and was below the normal range, following 2 months of normal flow at that site.

In northern Wyoming, mean flow in Tongue River near Dayton increased contraseasonally and was in the normal range, following 4 consecutive months of below-normal flow. Elsewhere in the State, flows remained within the normal range.

In eastern Oregon, monthly mean discharge in John Day River at Service Creek continued to increase seasonally and was in the normal range, after 11 consecutive months of below-normal flow. Elsewhere in Oregon, mean flows also increased seasonally, and remained in the normal range.

In the lowlands of western Washington, monthly mean flow in Chehalis River near Grand Mound continued to increase seasonally but was within the normal range, following 2 months of above-normal flow at that site. In Spokane River basin, in eastern Washington, and the adjacent area of northern Idaho, mean flow in Spokane River at Spokane, Washington, increased seasonally but remained below the normal range for the 12th consecutive month.

In northern Nevada, mean flow in Humboldt River at Palisade increased seasonally but was less than median and was in the normal range.

In Alberta, monthly mean discharge in Athabasca River at Hinton continued to decrease seasonally and was below the normal range for the 4th time in the past 5 months. Also in Alberta, mean flow in Bow River at Banff decreased seasonally and was below the normal range, after 2 months of normal flow at that site.

In northern British Columbia, where mean flow in Skeena River at Usk was below the normal range in September, flow increased into the normal range in October but remained below median. In the southern part of the Province, monthly mean discharge in Fraser River at Hope decreased seasonally and remained in the normal range.

In northern New Mexico, mean flow in Rio Grande below Taos Junction Bridge, near Taos, decreased seasonally and remained in the below-normal range for the

10th time in the past 11 months. Also in the northern part of the State, monthly mean discharge in Pecos River near Pecos continued to decrease seasonally and was below the normal range, after 10 consecutive months within the normal range. In southeastern New Mexico, mean flow in Delaware River near Red Bluff increased but remained below the normal range for the 4th consecutive month. In the southwestern corner of the State, monthly mean flow in Gila River near Gila continued to decrease seasonally but remained within the normal range.

In Arizona, streamflow was extremely variable, with record-high flows in some basins and below-normal flows in others. In the extreme southeastern part of the State, flooding occurred along San Pedro River early in the month. The monthly mean discharge of 1,134 cfs, and the daily mean of 20,600 cfs on the 9th, at the index station at Charleston (drainage area, 1,219 square miles) were highest for October in 66 years of record. This monthly mean was 131 times the October median flow, and the daily mean was 10 times the previous maximum daily mean for the month. Monthend reservoir contents in the State ranged from 14 percent above average for the combined contents of Lakes Mead and Mohave, to 86 percent below normal for San Carlos Reservoir. Contents of the Salt-Verde Reservoir system was 27 percent below average at monthend.

Contents of the Colorado River Storage Project decreased by 195,810 acre-feet during the month.

Ground-water levels in Washington rose slightly in the eastern part of the State, but were slightly below average; the level in the western Washington key well declined and was nearly 3 feet below average. In Idaho, levels generally declined seasonally and were below average in Boise Valley. Levels in wells in the Snake River Plain aquifer were all below average. The level in the alluvial aquifer of the Rathdrum Prairie in northern Idaho was below average at month's end. In western Montana, the levels in the terrace gravel wells at Missoula and Hamilton declined. The level at Missoula was more than 5 feet below average. In southern California, levels in selected observation wells declined in response to little or no precipitation during the month; levels continued below average. In Nevada, levels showed mixed trends in the four key wells, but were below average except in the well in Steptoe Valley, in the eastern part of the State, which continued above average. Despite a rise in the Las Vegas well, its level was at a new low for October, and a new monthly low was reached also at Truckee Meadows. Levels generally rose in most of Utah, but declined in the Blanding area in the southeastern part of the State. Levels continued below average in most of Utah. In southern Arizona, levels rose in all five index wells; even so, levels were at new October lows in three of the index wells, including the Tucson no. 2 and Elfrida wells. In New Mexico, the level in the well in the shallow alluvial aquifer in Eddy County, in the southern part of the Roswell basin, rose very slightly but was at a new October low. Significant rises occurred in the Hrna water-table well in Mimbres Valley and in the Berrendo-Smith artesian well in Pecos Valley, but levels continued below average.

ALASKA

Streamflow decreased seasonally at all index stations in the State and remained in the above-normal range for the 2d consecutive month at Little Susitna River near Palmer (drainage area, 61.9 square miles) in the south-central part of the State. The daily mean of 442 cfs on the 1st was highest for October in 29 years of record at that site. In the central part of the State, high carryover flow from September, augmented by runoff from above-normal precipitation during October, held monthly mean flow at Chena River at Fairbanks in the above-normal range for the first time in over 4 years.

Ground-water levels in the confined artesian aquifer in the Anchorage area rose 2 to 3 feet during the month with monthend levels generally in the normal range. Shallow water-table well levels were essentially unchanged from September.

HAWAII

Streamflow was variable throughout Hawaii. In the central part of the State, monthly mean flow of Kalihi Stream near Honolulu, on the island of Oahu, decreased contraseasonally to only 17 percent of median and was below the normal range. Elsewhere in the State, on the islands of Maui and Kauai, monthly mean flows increased seasonally and were in the normal range. On the southern island of Hawaii, flow decreased seasonally but remained in the normal range.

DISSOLVED SOLIDS AND WATER TEMPERATURES FOR OCTOBER AT DOWNSTREAM SITES ON SIX LARGE RIVERS

Station number	Station name	October data of following calendar years	Stream discharge during month: Mean (cfs)	Dissolved-solids concentration during month[a]: Minimum (mg/L)	Dissolved-solids concentration during month[a]: Maximum (mg/L)	Dissolved-solids discharge during month[a]: Mean (tons per day)	Dissolved-solids discharge during month[a]: Minimum (tons per day)	Dissolved-solids discharge during month[a]: Maximum (tons per day)	Water temperature during month[b]: Mean, in °C	Water temperature during month[b]: Minimum, in °C	Water temperature during month[b]: Maximum, in °C
	NORTHEAST										
01463500	Delaware River at Trenton, N.J.	1977*	17,520	....	....	.....	....	....	.....	.....	.....
	(Morrisville, Pa.)	1944–76	6,422	58	156	.....	463	8,300	.....	8.5	25.5
		(Extreme yr)		(1945)	(1953)		(1963)	(1955)			
			[4,025[c]]								
04264331	St. Lawrence River at	1977	301,000	167	168	136,000	133,000	138,000	12.5	11.0	16.0
	Cornwall, Ontario, near	1975–76	295,500	166	168	132,000	127,000	137,000	13.0	0.0	16.0
	Massena, N.Y. (streamflow station formerly at Ogdensburg, N.Y.)	(Extreme yr)	[234,500[c]]	(1976)	(1975)		(1975)	(1976)			
	SOUTHEAST										
07289000	Mississippi River at	1977	504,200	193	238	279,000	234,000	301,000	21.0	15.5	25.0
	Vicksburg, Miss	1975–76	355,600	192	271	231,000	117,000	338,000	19.0	15.0	23.5
		(Extreme yr)		(1975)	(1976)		(1976)	(1975)			
			[264,200[c]]								
	WESTERN GREAT LAKES REGION										
03612500	Ohio River at lock and dam 53, near Grand Chain, Ill.	1977	226,500	204	254	.....	85,100	206,000	.....	15.5	24.0
	(25 miles west of Paducah,	1954–76	111,500	135	330	.....	15,000	262,000	.....	12.0	26.0
	Ky.; streamflow station at Metropolis, Ill.)	(Extreme yr)	[89,100[c]]	(1960, 1963)	(1967)		(1973)	(1976)			
	MIDCONTINENT										
06934500	Missouri River at Hermann,	1977	89,500	236	415	75,600	54,900	142,000	16.0	13.0	22.0
	Mo. (60 miles west of St.	1975–76	64,000	383	459	73,400	51,800	98,900	15.5	10.0	20.0
	Louis, Mo.)	(Extreme yr)		(1975)	(1976)		(1976)	(1975)			
			[55,340[c]]								
	WEST										
14128910	Columbia River at	1977	93,900	101	117	27,000	18,400	36,200	15.0	14.5	17.0
	Warrendale, Oreg.	1975–76	128,900	78	108	32,300	20,200	48,900	16.5	14.0	19.5
	(30 miles east of Portland, Oreg.; streamflow station at The Dalles, Oreg.)	(Extreme yr)	[100,400[c]]	(1976)	(1975)		(1976)	(1975)			

[a]Dissolved-solids concentrations when not analyzed directly, are calculated on basis of measurements of specific conductance.
[b]To convert °C to °F: [(1.8 X °C) + 32] = °F.
[c]Median of monthly values for 30-year reference period, water years 1941–70, for comparison with data from current month.
*Dissolved-solids and water-temperature records not available.

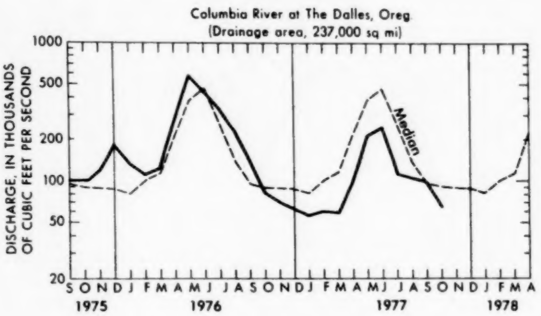
DISSOLVED SOLIDS AND WATER FOR OCTOBER ON SIX LARGE RIVERS

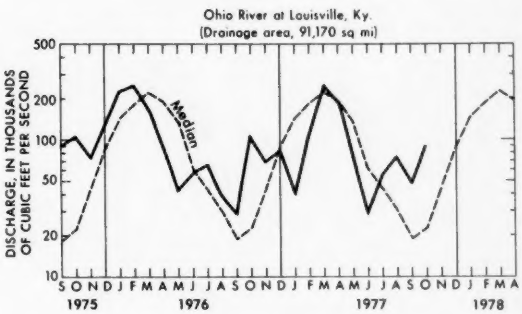
The table at left shows dissolved-solids and temperature data for October at six stream-sampling sites that are part of the National Stream Quality Accounting Network (NASQAN). NASQAN, as established by the U.S. Department of the Interior, Geological Survey, is designed to describe the water quality of the Nation's streams and rivers on a systematic and continuing basis, so as to meet many of the information needs of those involved in national or regional water-quality planning and management.

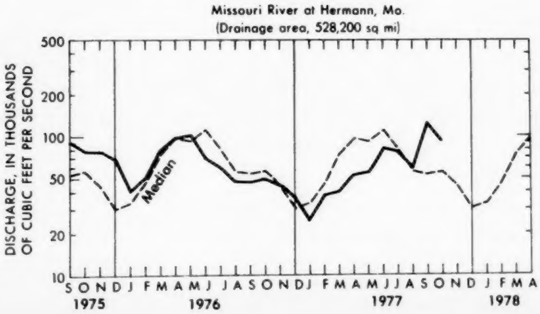
"Dissolved solids," as described in several columns of the table, are minerals dissolved in water and usually consist predominantly of silica and ions of calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulfate, chloride, and nitrate. These same minerals are among the most common components of the Earth's solid rocks and minerals, but gradually erode and at least partly dissolve as a part of natural weathering processes. Collectively these and other dissolved minerals constitute the dissolved-solids concentration expressed in milligrams per liter (mg/L) or the generally equivalent expression, parts per million (parts of dissolved matter in one million parts of water, by weight). Values of dissolved solids are convenient for comparing the quality of water from one time to another and from one place to another. Most drinking water contains between 50 and 500 mg/L of dissolved solids.

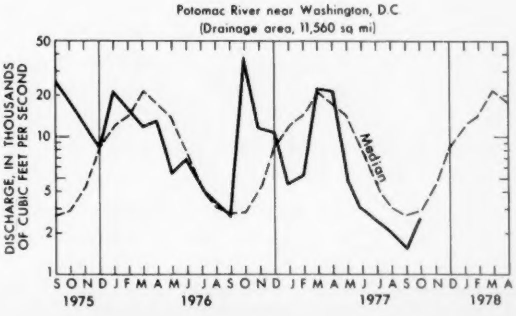
"Dissolved-solids discharge," expressed in tons per day, represents the total daily amount of dissolved minerals carried by the stream and is calculated by multiplying the dissolved-solids concentration (in mg/L) by the stream discharge (in cfs; times a unit conversion factor of .0027). Even though dissolved-solids *concentrations* are generally higher during periods of low streamflow than of high streamflow, the highest dissolved-solids *discharges* occur during periods of high streamflow because the total quantities of water, and therefore total load of dissolved minerals, are so much greater than at times of low flow.

HYDROGRAPHS OF FOUR LARGE RIVERS



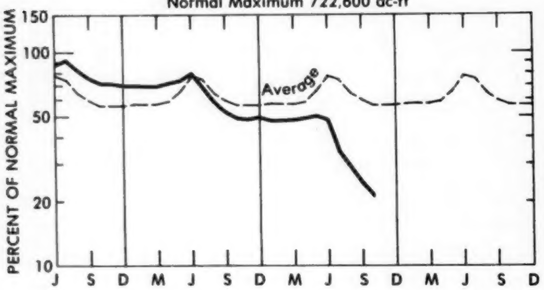




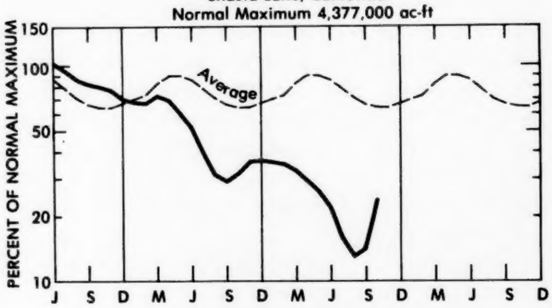


USABLE CONTENTS OF SELECTED RESERVOIRS AND RESERVOIR SYSTEMS, JUNE 1975 TO OCTOBER 1977

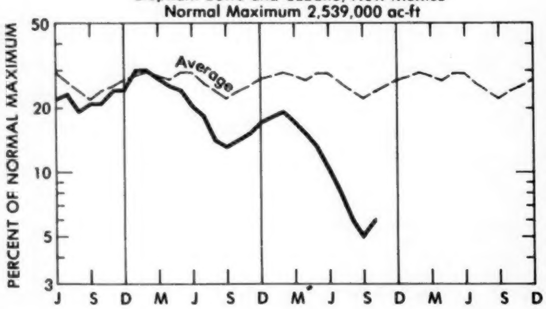
Colorado—Big Thompson Project, Colorado
Normal Maximum 722,600 ac-ft



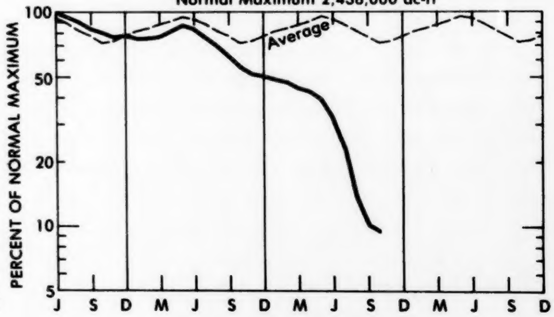
Shasta Lake, California
Normal Maximum 4,377,000 ac-ft



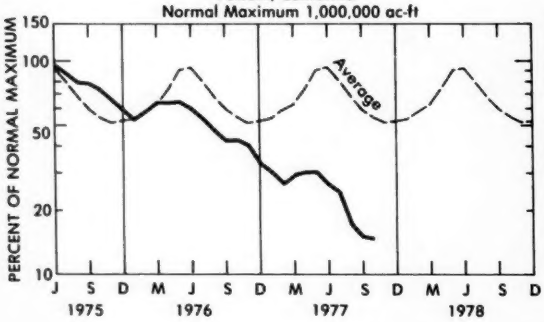
Elephant Butte and Caballo, New Mexico
Normal Maximum 2,539,000 ac-ft



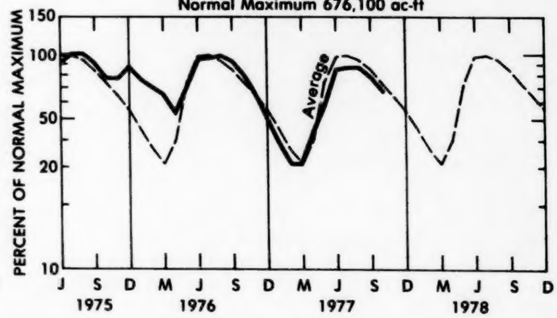
Clair Engle Lake (Lewiston), California
Normal Maximum 2,438,000 ac-ft



Folsom, California
Normal Maximum 1,000,000 ac-ft



Lake Chelan, Washington
Normal Maximum 676,100 ac-ft



Low-Storage Conditions Persist: Abnormally low contents continued to characterize reservoirs in various parts of the West, including five of the six reservoirs and reservoir systems shown on the above graphs. Usable contents of three reservoir systems at the end of October 1977, was lowest of record since the beginning of the two-year drought. In northern California, October rains produced relatively little runoff to reservoirs; storage at end of month in major reservoirs was only 34 percent of average and 48 percent of that of a year ago.

METRIC EQUIVALENTS OF UNITS USED IN THE WATER RESOURCES REVIEW

(Round-number conversions, to nearest four significant figures)

1 foot = 0.3048 meter 1 mile = 1.609 kilometers
1 acre = 0.4047 hectare = 4,047 square meters
1 square mile (sq mi) = 259 hectares = 2.59 square kilometers (sq km)
1 acre-foot (ac-ft) = 1,233 cubic meters
1 million cubic feet (mcf) = 28,320 cubic meters
1 cubic foot per second (cfs) = 0.02832 cubic meters per second = 1.699 cubic meters per minute
1 second-foot-day (cfsd) = 2,447 cubic meters
1 million gallons (mg) = 3,785 cubic meters = 3.785 million liters
1 million gallons per day (mgd) = 694.4 gallons per minute (gpm) = 2.629 cubic meters per minute = 3,785 cubic meters per day

USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF OCTOBER 1977

[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	End of Sept. 1977	End of Oct. 1977	End of Oct. 1976	Average for end of Oct.	Normal maximum
	Percent of normal maximum				
NORTHEAST REGION					
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	64	78	45	33	226,300 (a)
QUEBEC					
Allard (P)	77	94	91	56	280,600 ac-ft
Gouin (P)	80	79	83	66	6,954,000 ac-ft
MAINE					
Seven reservoir systems (MP)	71	89	91	52	178,500 mcf
NEW HAMPSHIRE					
First Connecticut Lake (P)	80	79	63	75	3,330 mcf
Lake Francis (FPR)	90	89	90	76	4,326 mcf
Lake Winnipesaukee (PR)	80	92	75	54	7,200 mcf
VERMONT					
Harriman (P)	75	78	73	60	5,060 mcf
Somerset (P)	78	91	80	68	2,500 mcf
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	75	82	74	71	3,394 mcf
NEW YORK					
Great Sacandaga Lake (FPR)	68	84	78	56	34,270 mcf
Indian Lake (FMP)	106	105	106	53	4,500 mcf
New York City reservoir system (MW)	72	96	86	.....	547,500 mg
NEW JERSEY					
Wanaque (M)	51	61	83	64	27,730 mg
PENNSYLVANIA					
Allegheny (FPR)	64	44	33	30	51,400 mcf
Pymatuning (FMR)	95	89	88	77	8,191 mcf
Raystown Lake (FR)	66	67	63	39	33,190 mcf
Lake Wallenpaupack (PR)	48	46	72	47	6,875 mcf
MARYLAND					
Baltimore municipal system (M)	72	69	98	84	85,340 mg
SOUTHEAST REGION					
NORTH CAROLINA					
Bridgewater (Lake James) (P)	89	91	88	80	12,580 mcf
Narrows (Badin Lake) (P)	92	94	98	96	5,617 mcf
High Rock Lake (P)	73	91	75	58	10,230 mcf
SOUTH CAROLINA					
Lake Murray (P)	80	80	83	61	70,300 mcf
Lakes Marion and Moultrie (P)	73	84	95	64	81,100 mcf
SOUTH CAROLINA––GEORGIA					
Clark Hill (FP)	62	64	69	53	75,360 mcf
GEORGIA					
Burton (PR)	87	82	83	65	104,000 ac-ft
Sinclair (MPR)	82	74	80	71	214,000 ac-ft
Lake Sidney Lanier (FMPR)	50	54	54	49	1,686,000 ac-ft
ALABAMA					
Lake Martin (P)	84	83	83	65	1,373,000 ac-ft
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	36	42	38	33	1,156,000 cfsd
Douglas Lake (FPR)	39	32	38	23	703,100 cfsd
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	61	56	53	48	510,300 cfsd
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	44	52	49	38	1,452,000 cfsd
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	59	52	35	47	745,200 cfsd
WESTERN GREAT LAKES REGION					
WISCONSIN					
Chippewa and Flambeau (PR)	94	95	64	75	15,900 mcf
Wisconsin River (21 reservoirs) (PR)	69	79	21	61	17,400 mcf
MINNESOTA					
Mississippi River headwater system (FMR)	26	28	11	29	1,640,000 ac-ft
MIDCONTINENT REGION					
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	78	77	89	.....	22,640,000 ac-ft
SOUTH DAKOTA					
Angostura (I)	48	50	60	72	127,600 ac-ft
Bell Fourche (I)	15	27	11	35	185,200 ac-ft
Lake Francis Case (FIP)	70	60	66	56	4,834,000 ac-ft
Lake Oahe (FIP)	72	70	80	.....	22,530,000 ac-ft
MIDCONTINENT REGION––Continued					
SOUTH DAKOTA––Continued					
Lake Sharpe (FIP)	103	102	103	92	1,725,000 ac-ft
Lewis and Clarke Lake (FIP)	96	97	95	95	477,000 ac-ft
NEBRASKA					
Lake McConaughy (IP)	62	64	66	67	1,948,000 ac-ft
OKLAHOMA					
Eufaula (FPR)	92	88	72	83	2,378,000 ac-ft
Keystone (FPR)	99	89	66	88	661,000 ac-ft
Tenkiller Ferry (FPR)	94	96	78	89	628,200 ac-ft
Lake Altus (FIMR)	71	69	56	47	134,500 ac-ft
Lake O'The Cherokees (FPR)	90	85	72	81	1,492,000 ac-ft
OKLAHOMA––TEXAS					
Lake Texoma (FMPRW)	96	91	90	92	2,722,000 ac-ft
TEXAS					
Bridgeport (IMW)	80	76	86	44	386,400 ac-ft
Canyon (FMR)	90	91	94	67	385,600 ac-ft
International Amistad (FIMPW)	95	94	101	76	3,497,000 ac-ft
International Falcon (FIMPW)	93	90	100	76	2,667,000 ac-ft
Livingston (IMW)	96	95	100	72	1,788,000 ac-ft
Possum Kingdom (IMPRW)	90	87	93	102	569,400 ac-ft
Red Bluff (PI)	6	6	21	28	307,000 ac-ft
Toledo Bend (P)	80	78	88	73	4,472,000 ac-ft
Twin Buttes (FIM)	77	75	92	22	177,800 ac-ft
Lake Kemp (IMW)	72	67	68	88	268,000 ac-ft
Lake Meredith (FMW)	40	39	41	38	821,300 ac-ft
Lake Travis (FIMPRW)	77	76	91	79	1,144,000 ac-ft
THE WEST					
WASHINGTON					
Ross (PR)	79	77	97	85	1,052,000 ac-ft
Franklin D. Roosevelt Lake (IP)	92	95	94	97	5,232,000 ac-ft
Lake Chelan (PR)	79	67	80	73	676,100 ac-ft
Lake Cushman	86	84	81	86	359,500 ac-ft
Lake Merwin (P)	102	105	97	84	246,000 ac-ft
IDAHO					
Boise River (4 reservoirs) (FIP)	13	16	54	48	1,235,000 ac-ft
Coeur d'Alene Lake (P)	77	60	54	54	238,500 ac-ft
Pend Oreille Lake (FP)	88	64	44	72	1,561,000 ac-ft
IDAHO––WYOMING					
Upper Snake River (8 reservoirs) (MP)	13	19	58	50	4,401,000 ac-ft
WYOMING					
Boysen (FIP)	59	61	92	83	802,000 ac-ft
Buffalo Bill (IP)	45	43	68	75	421,300 ac-ft
Keyhole (F)	57	57	66	40	199,900 ac-ft
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I)	38	38	55	42	3,056,000 ac-ft
COLORADO					
John Martin (FIR)	0	0	0	12	364,400 ac-ft
Taylor Park (IR)	44	42	61	53	106,200 ac-ft
Colorado–Big Thompson project (I)	24	21	49	56	722,600 ac-ft
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Navajo, and Blue Mesa Reservoirs (IFPR)	62	62	78	.....	31,280,000 ac-ft
UTAH––IDAHO					
Bear Lake (IPR)	55	54	79	57	1,421,000 ac-ft
CALIFORNIA					
Folsom (FIP)	15	14	42	53	1,000,000 ac-ft
Hetch Hetchy (MP)	32	29	28	47	360,400 ac-ft
Isabella (FIR)	7	6	13	22	551,800 ac-ft
Pine Flat (FI)	7	7	23	35	1,014,000 ac-ft
Clair Engle Lake (Lewiston) (P)	10	9	55	71	2,438,000 ac-ft
Lake Almanor (P)	52	52	55	47	1,036,000 ac-ft
Lake Berryessa (FIMW)	48	47	64	75	1,600,000 ac-ft
Millerton Lake (FI)	39	37	46	31	503,200 ac-ft
Shasta Lake (FIPR)	14	15	33	64	4,377,000 ac-ft
CALIFORNIA––NEVADA					
Lake Tahoe (IPR)	0	0	37	50	744,600 ac-ft
NEVADA					
Rye Patch (I)	33	27	64	71	157,200 ac-ft
ARIZONA––NEVADA					
Lake Mead and Lake Mohave (FIMP)	77	77	79	68	27,970,000 ac-ft
ARIZONA					
San Carlos (IP)	1	2	0	12	1,073,000 ac-ft
Salt and Verde River system (IMPR)	26	24	48	34	2,073,000 ac-ft
NEW MEXICO					
Conchas (FIR)	33	31	24	76	352,600 ac-ft
Elephant Butte and Caballo (FIPR)	5	6	14	24	2,539,000 ac-ft

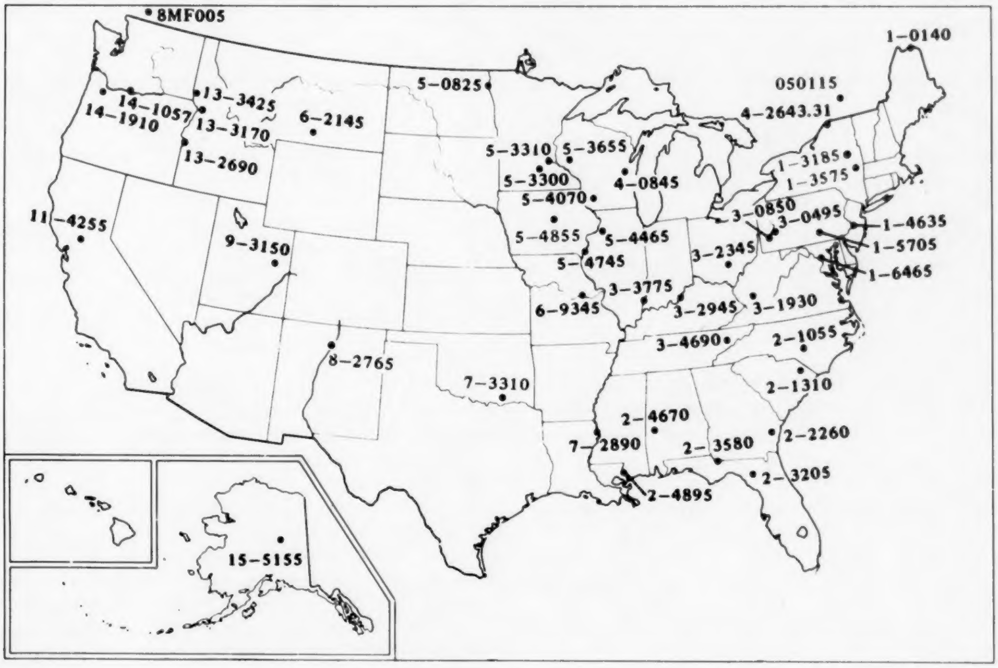
[a]Thousands of kilowatt-hours (the potential electric power that could be generated by the volume of water in storage).

FLOW OF LARGE RIVERS DURING SEPTEMBER 1977

Station number*	Stream and place of determination	Drainage area (square miles)	Mean annual discharge through September 1970 (cfs)	October 1977					
				Monthly dis-charge (cfs)	Percent of median monthly discharge, 1941–70	Change in dis-charge from previous month (percent)	Discharge near end of month		
							(cfs)	(mgd)	Date
1–0140	St. John River below Fish River at Fort Kent, Maine.	5,690	9,397	20,340	432	+406	15,200	9,820	31
1–3185	Hudson River at Hadley, N.Y	1,664	2,791	7,078	588	+186	4,200	2,700	31
1–3575	Mohawk River at Cohoes, N.Y	3,456	5,450	15,140	662	+97	......	......	.....
1–4635	Delaware River at Trenton, N.J	6,780	11,360	17,520	435	+222	23,300	15,100	24
1–5705	Susquehanna River at Harrisburg, Pa.	24,100	33,670	68,460	870	+120	68,400	44,200	25
1–6465	Potomac River near Washington, D.C.	11,560	[1] 10,640	2,610	92	+69	2,320	1,500	31
2–1055	Cape Fear River at William O. Huske Lock near Tarheel, N.C.	4,810	4,847	2,637	125	-15	5,940	3,840	31
2–1310	Pee Dee River at Peedee, S.C	8,830	9,098	4,170	90	-37	8,160	5,270	27
2–2260	Altamaha River at Doctortown, Ga.	13,600	13,380	4,883	92	-6	4,420	2,860	28
2–3205	Suwannee River at Branford, Fla	7,740	6,775	3,030	66	-23	2,560	1,650	31
2–3580	Apalachicola River at Chattahoochee, Fla.	17,200	21,690	10,700	98	-9	10,590	6,840	31
2–4670	Tombigbee River at Demopolis lock and dam near Coatopa, Ala.	15,400	21,700	27,980	1,044	+259	66,800	43,200	26
2–4895	Pearl River near Bogalusa, La	6,630	8,533	5,993	301	+33	4,340	2,800	31
3–0495	Allegheny River at Natrona, Pa	11,410	[1] 18,700	26,400	605	+64	11,500	7,400	25
3–0850	Monongahela River at Braddock, Pa.	7,337	[1] 11,950	10,600	337	+199	9,600	6,200	25
3–1930	Kanawha River at Kanawha Falls, W.Va.	8,367	12,370	9,977	220	+148	7,070	4,570	23
3–2345	Scioto River at Higby, Ohio	5,131	4,337	1,666	286	+54	950	610	25
3–2945	Ohio River at Louisville, Ky[2]	91,170	110,600	90,560	403	+91	48,000	31,000	25
3–3775	Wabash River at Mount Carmel, Ill.	28,600	26,310	25,065	491	+70	21,400	13,800	31
3–4690	French Broad River below Douglas Dam, Tenn.	4,543	[1] 6,528	4,543	129	-41	......	......	.....
4–0845	Fox River at Rapide Croche Dam, near Wrightstown, Wis.[2]	6,150	4,142	2,050	96	+67	......	......	
02MC002 (4–2643.31)	St. Lawrence River at Cornwall, Ontario–near Massena, N.Y.[3]	299,000	239,100	299,600	128	+8	281,000	182,000	31
050115	St. Maurice River at Grand Mere, Quebec.	16,300	24,900	16,900	93	+42	17,400	11,200	31
5–0825	Red River of the North at Grand Forks, N. Dak.	30,100	2,439	1,250	92	+131	1,050	680	31
5–3300	Minnesota River near Jordan, Minn	16,200	3,306	1,050	110	+185	996	644	25
5–3310	Mississippi River at St. Paul, Minn	36,800	[1] 10,230	9,900	158	+61	8,960	5,790	25
5–3655	Chippewa River at Chippewa Falls, Wis.	5,600	5,062	8,378	324	-27	4,000	2,600	30
5–4070	Wisconsin River at Muscoda, Wis	10,300	8,457	7,231	132	+67	......	......	.....
5–4465	Rock River near Joslin, Ill	9,520	5,288	4,850	201	+57	5,530	3,570	27
5–4745	Mississippi River at Keokuk, Iowa	119,000	61,210	74,100	233	+34	55,500	35,900	31
5–4855	Des Moines River below Raccoon River at Des Moines, Iowa.	9,879	3,796	2,222	247	+34	3,100	2,000	31
6–2145	Yellowstone River at Billings, Mont.	11,795	6,754	3,673	93	+13	3,420	2,210	31
6–9345	Missouri River at Hermann, Mo	528,200	78,480	90,820	164	-25	162,000	105,000	27
7–2890	Mississippi River at Vicksburg, Miss.[4]	1,144,500	552,700	504,200	191	+33	365,000	236,000	31
7–3310	Washita River near Durwood, Okla	7,202	1,379	218	43	-30	315	204	31
8–2765	Rio Grande below Taos Junction Bridge, near Taos, N. Mex.	9,730	732	193	68	+2	188	122	31
9–3150	Green River at Green River, Utah	40,600	6,369	1,410	57	+28	1,900	1,230	31
11–4255	Sacramento River at Verona, Calif	21,257	18,370	4,217	48	-32	4,200	2,700	20
13–2690	Snake River at Weiser, Idaho	69,200	17,670	10,800	74	+21	10,900	7,040	25
13–3170	Salmon River at White Bird, Idaho	13,550	11,060	4,826	99	+32	4,190	2,710	25
13–3425	Clearwater River at Spalding, Idaho	9,570	15,320	5,516	145	+29	4,440	2,870	25
14–1057	Columbia River at The Dalles, Oreg.[5]	237,000	194,000	66,530	72	-33	......	......	.....
14–1910	Willamette River at Salem, Oreg	7,280	23,370	7,122	98	+65	11,160	7,210	27–31
15–5155	Tanana River at Nenana, Alaska	25,600	24,040	14,450	89	-55	5,000	3,200	31
8MF005	Fraser River at Hope, British Columbia.	83,800	95,300	58,800	77	-29	52,500	33,900	28

[1] Adjusted.
[2] Records furnished by Corps of Engineers.
[3] Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y. when adjusted for storage in Lake St. Lawrence.
[4] Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.
[5] Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.
*The U.S. station numbers as listed in this table are in a shortened form previously in use, and used here for simplicity of tabular and map presentation. The full, correct number contains 8 digits and no punctuation marks. For example, the correct form for station number 1–3185 is 01318500.

SELECTED STREAM-GAGING STATIONS ON LARGE RIVERS



Location of stream-gaging stations on large rivers listed in table on page 16.

WATER RESOURCES REVIEW

October 1977

Based on reports from the Canadian and U.S. field offices; completed November 9, 1977

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EXPLANATION OF DATA

Cover map shows generalized pattern of streamflow for October based on 20 index stream-gaging stations in Canada and 130 index stations in the United States. Alaska and Hawaii inset maps show streamflow only at the index gaging stations which are located near the points shown by the arrows.

Streamflow for October 1977 is compared with flow for October in the 30-year reference period 1941–70. Streamflow is considered to be *below the normal range* if it is within the range of the low flows that have occurred 25 percent of the time (below the lower quartile) during the reference period. Flow for October is considered to be *above the normal range* if it is within the range of the high flows that have occurred 25 percent of the time (above the upper quartile).

Flow higher than the lower quartile but lower than the upper quartile is described as being *within the normal range*. In the Water Resources Review the median is obtained by ranking the 30 flows of the reference period in their order of magnitude; the highest flow is number 1, the lowest flow is number 30, and the average of the 15th and 16th highest flows is the median.

The normal is an average (but not an arithmetic average) or middle value; half of the time you would expect the October flows to be below the median and half of the time to be above the median. Shorter reference periods are used for the Alaska index stations because of the limited records available.

Statements about *ground-water levels* refer to conditions near the end of October. Water level in each key observation well is compared with average level for the end of October determined from the entire past record for that well or from a 20-year reference period, 1951–70. *Changes in ground-water levels*, unless described otherwise, are from the end of September to the end of October.

The Water Resources Review is published monthly. Special-purpose and summary issues are also published. Issues of the Review are free on application to the Water Resources Review, U.S. Geological Survey, Reston, Virginia 22092.

Although the basic kinds and variety of water problems remain virtually unchanged over the years because these problems are linked to the nature of water itself, the relative emphasis given to different problems does follow variable trends. These trends depend upon the influence and timing of such things as population growth, environmental consciousness, increased competition for water by agriculture and industry (including utilities), natural catastrophes (such as floods and droughts), and the state of the economy. The change in relative emphasis given to various water problems can be charted using the content analysis technique of historians––the relative number of times a particular sub-class (for example, kind of water problem) of a subject is mentioned in public documents dealing with the subject as a whole, in this case "water."

When the 19th century began, the center of informed attention was on canal navigation and related environmental anxieties stemming from a fear that land development would exacerbate flood, water-supply, and erosion problems. As that century matured, the environmental questions retreated from public notice, and the dominant questions concerned irrigation in the West and public water supplies for burgeoning cities in the East. As the 20th century began, hydroelectric power joined the list. The 1930's saw great emphasis upon floods and droughts.

Figure 1 shows the results of a content analysis of the following reports since the 1920's:

Reports examined

1920–29 Transactions, American Society Civil Engineers, Volumes 83–93.

1936–37 Drainage Basin Problems and Programs, December 1936: National Resources Committee (1937), 540 pages.

1936–37 Drainage Basin Problems and Programs, 1937 revision: National Resources Committee (1938), 154 pages.

Transactions, American Society of Civil Engineers, Volumes 101–102.

1950 A Water Policy for the American People (445 pages); and Ten Rivers in America's Future (801 pages): Volumes 1 and 2 of the President's Water Resources Policy Commission.

1961 Report of Senate Select Committee on National Water Resources, 87th Congress, 1st Session, Report No. 29, 1961 (main report––147 pages––plus reports on hearings in 25 cities).

1973 Water Policies for the Future, 1973: National Water Commission (579 pages).

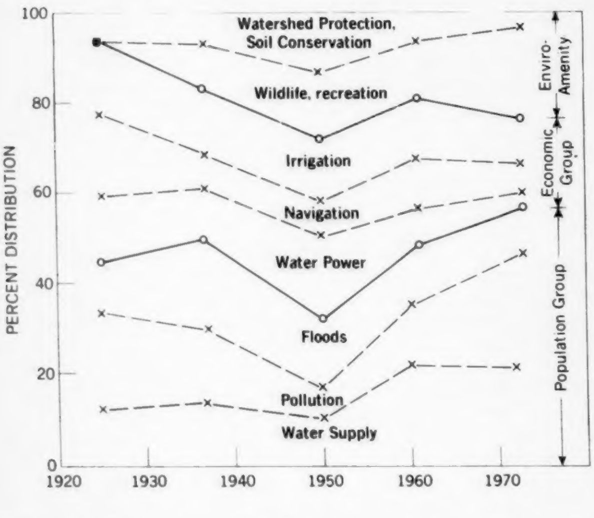

Figure 1.––Shifting emphasis in kinds of water problems referred to in selected public documents, 1920–73.

According to this content analysis, irrigation, water power, and floods, which were the big problems that dominated national reports on water problems 40 years ago, have steadily receded to be replaced by a set of environmental issues that began to emerge as early as the 1930's. In 1928, the enviro-amenity factors (watershed protection, soil conservation, recreation, fish, wildlife) accounted for only about 6 percent in the published reports; in 1972, these factors increased so that they occupied nearly 25 percent of the attention devoted to water problems in these reports.

There is little if any overall trend in the population group. With respect to water pollution, it must be remarked that increase in attention since the 1920's may not be so large as one might surmise (22 percent in 1920 to 26 percent in 1972). However, a content analysis of the public press (instead of public documents) might show a greatly different result. The general downward trend in the economic group is made up in the increasing trend in the enviro-amenity group.

Even more dramatic change can be seen in a steady increase in the attention accorded to the "support" factors (not identified specifically on the graph) which include such matters as policy, planning, economic analysis, research, basic data, or technology.

	1936–37 (percent)	1950 (percent)	1960–61 (percent)	1972 (percent)
Support	13	25	31	45

In 1936–37, these support factors were noted only in about 13 percent of the total, steadily increasing to 45 percent in 1972. Rather than reporting on specific projects which dominated national concern in the 1930's, a national review of water problems today would deal about half with planning, economics, and such matters. This trend did not appear to extend to increasing attention to basic data, research, or even technology––subjects that were among those receiving major attention in the early 1960's.

As we head for the 1980's, climate-related anxieties may bring increased attention upon the dependability of water supplies. Quality will continue as an important factor controlling the usefulness of water supply. The set of items labeled "support" will probably continue to be prominent in the public view, but water planning may be enlarged to consider evaluations of existing water programs and of cause-effect relations and results of past actions as guides to the future.

Walter B. Langbein